on p. 403 we read: "The style of Polybius is clear, but somewhat prolix; he cares little for literary elegance; his tone is always serious, because seriousness befits the dignity of his purpose. There are few traces of imagination and hardly a gleam of humor. Polybius narrates without dramatic power, and interrupts his narrative by disquisitions and discussions conducted without variety or imagination. He is far from being a literary artist, but as an historian he occupies a position of honor because of his industrious search for information." Such a critic would nevertheless fail to do justice to the real merits of the book; which, however, it may be repeated, ought by no means to be used as indicated in the preface, but kept as a manual for reference chiefly.

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The Teaching of Physics in the Secondary School. By EDWIN H. HALL, Being pp. 231–371 of *The Teaching of Chemistry and Physics in the Secondary School.* By ALEXANDER SMITH AND EDWIN H. HALL. New York: Longmans Green & Co., 1902.

ONE of the lamentable characteristics of the teaching profession is the fact that the work of few teachers is determined by conscious aims — that few have a definite educational purpose which shapes the nature and quality of their instruction. In fact, it almost seems as if the statement were warranted that most teachers are satisfied if they attain the immediate object of inducing their pupils to learn their daily lesson as presented in the text which has been given them to use. It does not require much thought, however, to make one perceive that a concrete and definite conception of the good to be gained from the instruction by the student is the very first essential of efficient teaching. Hence anything which will tend to turn the thoughts of teachers to a consideration of the question of conscious aim in teaching is very valuable.

Looking at the teaching profession from this point of view, the "American Teachers Series," of which the book under consideration is one volume, should prove of great service in elevating the quality of teaching in our secondary schools: for no one can read such a book without being compelled to consider what his excuse for teaching this or that subject really is; and such thought and discussion must lead to a clearing of one's own mental atmosphere and a consequent increased efficiency in the profession.

Hence Professor Hall's contribution to this side of the teacher's thought-life cannot but be welcomed as a step in the right direction, and all teachers of physics are urged to read it carefully, and to ponder diligently upon the propositions which are therein set forth.

The work is divided into thirteen chapters, as follows: (1) "Whether to be a Teacher of Physics;" (2) "Preparation for Teaching;" (3) "The Teacher as Student, Observer, and Writer;" (4) "Problems of Laboratory Practice;" (5) "School Text-Books of Physics;" (6) "Discovery, Verification, or Inquiry;" (7) "The Technique of Laboratory Management;" (8) "Lectures and Recitations;" (9) "Physics in Primary and Grammar Schools;" (10) "Physics in Various Kinds of Secondary Schools;" (11) "On the Presentation of Dynamics;" (12) "Plan and Equipment of a Laboratory;" (13) "Physics Teaching in Other Countries."

In chapter 1 the essential characteristics of a teacher of physics are shown to be a "capacity for clear, sustained, correct thinking," and an "instinct for machinery." These are certainly necessary traits for a man who desires to master physics, but should we not also add as of equal importance several characteristics which perhaps are implied as general characteristics which every teacher should have, namely, love of nature and art, enthusiasm in the pursuit of his subject, interest in his pupils, sense of humor, etc ?

In the second chapter the preparation for teaching is treated. There are many good suggestions here. The teacher is informed "That the time never comes when he can say, 'I know enough for my work, I will be a student no more.'" He is also urged to give sufficient attention to practical things, engineering work in particular, and to be sure to acquire manipulative skill and to develop a habit of general observation. There is, however, one point in which we should like to have seen a more definite and extended treatment. This point is that mentioned at the outset, namely, that of the object of studying science. Upon this question we read: "The objects of education in science are, on the one hand, to make men capable, self-sustaining, physically comfortable; on the other hand, to increase their capacity and opportunities for intellectual enjoyment. Each of these objects has an ethical aspect; for men who are materially well-to-do, and intellectually happy, can hardly help being good men and good citizens." It is perfectly clear that so general a statement can scarcely serve as the formulation of a definite purpose for a teacher to adopt as his ideal, even if it were strictly correct and the highest possible ideal to which he could attain. But is it correct that men who are materially well-to-do and intellectually happy are necessarily good citizens? Does the ideal include a development of the sturdy honesty which is the first characteristic of the scientist? And where does the power to attack a problem in the scientific method and to develop the imagination come in ?

It would be disappointing, indeed, if this were all the help which an aspiring teacher could draw from the book toward forming his own educational purpose. There are other more definite hints, however, for we read on p. 314: "The immediate aim, though not the sole object, of instruction in physics, should be to give the power and the habit of using physical knowledge." Also in chap. 10 the point is again discussed. We are here told of the work of the Committee of the National Educational Association on College Entrance Requirements in Physics, a committee of which Professor Hall was chairman. It seems that the committee never met and did not submit any regular report, but the chairman sent in his own views and requested the other members to do the same. In Professor Hall's statement, which was indorsed by the National Educational Association, we find a more concise and definite formulation of an educational purpose. After discussing the essentials of an elementary course in physics, such as so many hours of laboratory work, so much lecture work, etc., we are told that it is all intended to help the pupil to gain "not merely empirical knowledge, but, as far as practicable, a comprehensive and connected view of the most important facts and laws in elementary physics." Does not this seem to be a veritable putting of the cart before the horse? For, while that comprehensive view is very desirable, is it the essential claim of physics to an important place in the school and college curriculum? It seems to us rather that the real moving power involved is the ability to think clearly and to reason by the scientific method — this is the horse; and the cart, which follows of necessity, is the knowl-

edge of the laws of physics. For are these laws of themselves so vital to the average man that it is advisable to spend as much time in their acquirement as is now expended? To be sure, that knowledge is of great worth, but can its value be compared with that of the power to reason clearly and according to the scientific method? If from his physics work a man has learned to think by the scientific method, *i. e.*, to grasp clearly the salient points in any phenomenon, to use his imagination in seeing connection between those points and the characteristics of other things, to draw an unbiased conclusion, and then to hold himself ready at any time to test that conclusion in every way, and abandon it or modify it when necessary — if he has attained that power, has he not something that will be of inestimable value to him whatever he does? What would our politics be if all men determined how to vote in this way? The laws of physics generally pass out of mind in a short time, but the scientific habit f thought when once acquired remains and will always be permanently useful.

But even if it is granted that the idea of developing a habit of scientific thought is implicitly contained in the statement of the end of studying physics as advocated by Professor Hall, there are yet several other important factors in such a purpose which do not appear to be even remotely suggested. Professor Hall will surely not deny the importance of connecting the scientific principles which are learned at school with the ordinary experiences of the daily life of the students. Every physics teacher must be aware that few students see the application of the formal experiment in the laboratory to the phenomena of daily experience. And yet is not such application highly important? Should the students be so instructed that they fail to see the connection between nature and the laboratory? Must the students wait till they have left school before they discover that true physics teaches them to

> "Find tongues in trees, books in the running brooks,
> Sermons in stones, and good in everything"?

Following the statement of the aim in teaching physics is the list of experiments which is generally known as the Harvard descriptive list, and with which every physics teacher is familiar. While the list contains some experiments which seem rather barren in thought production, there is no reason why a teacher could not select forty of the sixty experiments given and, by presenting the work in the proper way, make it vital and efficient in training in scientific thinking. Especially is this true of a teacher who has developed a high and definite purpose in teaching. When such a list is presented, however, there may be a danger that the average teacher, who had allotted to him the task of so instructing a student in such a problem as the determination of specific gravity, for example, that the student will be able to receive entrance credit for it, will execute the task in a rather mechanical way. For what instructor, after being informed that his pupil must have determined specific gravity according to the explanation given in some text, will do any more than assume Archimedes's principle and put the student through the mechanical and arithmetical operation of applying that principle to certain specified cases? Would it be harder for the teacher so to arrange the work that Archimedes's principle was reached as a result of the experiment, rather than that the result should be that the specific gravity of the piece of iron was

$$S = \frac{\text{weight in air}}{\text{loss of weight in water}} = 7.8?$$

The purposes and nature of the college-requirement physics having been thus set forth, attention is called to the general approval which it has received; for we read:

It appears, then, that we have, in the course of work outlined in the preceding quotations, a type of college-entrance requirement in physics which is tolerably well defined and widely approved. Whether this type is established and maintained as generally as it is approved, may be an open question. In that part of the country which comes under my personal observation it is very generally established. But in this same region the boys who go through a high-school course, without having preparation for college in view, do not, as a rule, take just this course of physics. They take one which is more "practical" or more "general" or more "popular," almost always, I believe, a course that involves less close attention and hard thinking. This fact naturally raises a number of questions. Is the college requirement, as interpreted and maintained by Harvard, for example, more severe than it should be? Are its applications to everyday life too remote? Does it require too much use of mathematics? . . . . Do the teachers who devise the courses of physics followed in the "English high schools," and other schools of the same general character, virtually express an unfavorable judgment of the college requirement physics for boys who are not to go to college?

It is possible that some of these questions would be and should be generally answered in the affirmative, but this is not the inevitable conclusion. There is still the possibility that those who have advocated the same work for boys who are to go to college as for boys who are not to go to college have overlooked one very important fact, namely, that two sets of boys may not be just alike in their mental traits and attainments. . . . . The ordinary city high school will therefore continue to have a general class of pupils who are not capable of going side by side with the pupils of the Latin schools—a class who have left the grammar schools comparatively old, and will leave the high school at a lower intellectual level than their Latin school contemporaries. . . . .

Furthermore, even if the natural difference in kind of pupils did not exist, the fact that the pupils in one school are preparing to meet requirements set by an authority outside the school, while the pupils in the other school are without this stimulus, will probably always keep the general standard of the work higher in the former school than in the latter.

For the high-school course in physics, as distinguished from the college-requirement course, there is not, so far as I am aware, any general description arrived at by formal consensus of opinion. The following extract from the official description of the physics work in the high school of Brookline, Mass., gives account of a course developed by Mr. John C. Packard, the teacher of physics in that school, which is in marked and interesting contrast with the college-requirement course:

There are two courses in physics.

"1. The so-called 'popular course,' the fundamental aims of which are:

"(*a*) To develop in the pupil the habit of steady, persistent, logical thinking;

"(*b*) To render him fairly intelligent in reference to his own scientific environment;

"(*c*) To beget a sense of power in his own ability to appreciate scientific truth and to draw legitimate conclusions from simple data;

"(*d*) To teach him to apply the elements of algebra and geometry to the problems of daily life; and finally,

"(*e*) To arouse within him a deep sense of appreciation of all that modern science has done and is still doing for the comfort and convenience of the race."

With these ends in view the head of the department, in common with many others, has discovered that but very little reliance can be placed upon the ordinary text-book, since so few opportunities are given in the average manual for any original independent thinking, and since, in general, such books contain so little of anything like a practical application of the principles of physics to the phenomena of daily life. . . . . I am far from asserting that the course outlined by Mr. Packard is not far better for the average high-school pupil, boy or girl, than the college preparatory course, which is also given in the same school. Mr. Packard, and others who, like him, have worked out the problem of general high-school physics approximately to their own satisfaction on somewhat new lines, will do a service to the public by putting the results of their experimentation into the form of text-books or manuals available for all teachers. These books may or may not prove to be generally acceptable

and usable; but in any case they will be an important contribution to that vigorous trying-out process through which all methods of science teaching are now going in the schools of this country.

We have quoted thus at length because this section of the book gives a very interesting comparison of two very different conceptions of the aims of physics teaching. This state of affairs which is described, namely, the coexistence of two totally distinct courses in physics, seems to indicate that physics teaching is in a transition state. Hence the suggestion to submit the newer course to rigid and searching trial is to be encouraged in every way. We confess to have a very strong leaning toward the point of view of the newer course. We heartily recognize the great service which the Harvard descriptive list has rendered in promoting the welfare of physics teaching in this country; for it gave something perfectly definite as a guide for the work. It is perfectly clear that something well defined must be produced by those of us who believe that the newer course is a vital improvement on the other before we can expect to prove the ability of such a course to yield far better results than the present college-requirement work. It is to be hoped that such a definite formulation of the plan of work will not be long delayed.

It would be interesting to know what led the high-school teachers to introduce a "popular" course side by side with the regular college-requirement course. We are rather inclined to believe that it was because the teacher could not interest the majority of his pupils in the college-preparatory course. This does not seem to us to glorify that course, for is it a thing to be proud of that there are numerous students in what are called the English high schools who seem incapable of following the work in physics done by the more fortunate (?) brothers in the Latin schools? If we study the operation of the old curriculum, we find many children falling out — children who are the despair of their teachers, and for whom the parents feel obliged to apologize. In fact, so many fall out that only one-third or one-fourth remain to graduate. There are many explanations of this repeated failure — explanations quite convincing to those who offer them: the children are dull; the standards are high; the school is very particular; it is not meant for the incompetent. But has not the matter quite a different aspect if we are as willing to call into question the wisdom of the teachers and the studies as we are to decry the abilities of the children? There are institutions, running in the name of education, which boast of the number of students who are annually squeezed out. Is not this boasting of one's own inefficiency? What would we think of a mill that discarded more than half of the raw material? And yet Professor Hall tells us that the high schools will continue to have a class of pupils who are not capable, when it comes to the preparatory physics, of going side by side with the pupils of the Latin schools? "What would such a high school undertake to do in physics?" he asks. "Should it follow the college preparatory course as far as it can, taking half or two-thirds of it, for example; or should it maintain a course designed with especial reference to the character and aims of its own pupils? I cannot doubt that the latter alternative will and ought to prevail, etc." Naturally, for if the college-preparatory course has proved its inefficiency by squeezing out the majority of the students, it would be only common justice to substitute for the college-requirement course one which, by appealing to a larger body of human children, proved itself to be more interesting, more useful, more vital, and, in a word, more natural. We are even ready to stand accused of the heresy of believing that possibly the brilliant children from the Latin school might gain a touch of true nature

from such a course, in spite of their ability to pass successfully through the college-requirement course.

It is certainly true, as Professor Hall says, that a college-entrance requirement may act as a stimulus in keeping up the standard of the work. But is a college requirement, over which you have no control and with which you find yourself in little sympathy, a better stimulus to thorough and conscientious work than the knowledge that your students are interested and gaining much human power from their work, and that you are in some measure attaining the ideal which you have set up for yourself in the way of a dynamic purpose in education? Moreover, does the introduction of the popular course in the English high schools point to the conclusion that the college-entrance requirement may act as a detriment to the betterment of physics-teachings in the schools? Truly it would not be the first time that the college has imposed upon the schools requirements which have proved to be burdens rather than stimuli.

But we must not linger too long on this subject, for the questions involved are, we all agree, matters to be settled by experiment. The questions which we should like to discuss with Professor Hall are so numerous that we find it hard to stop. One, however, seems to be of greater importance than the rest, namely, the question of the use of experiments as verification. Upon this point we read:

> Let us now consider the method of verification. It is hard to imagine any disposition of mind less scientific than that of one who undertakes an experiment knowing the result to be expected from it and prepared to look so long as may be necessary to attain this result. Better by far to take a statement on faith than to cultivate the habit of hunting for evidence in its favor and shutting one's eyes to inconvenient evidence against it. A trait that has characterized the great masters of science has been the power and habit of sternly searching the evidence for, as well as the evidence against, their own propositions.
>
> The suggestion that pupils whose minds are prejudiced in favor of a certain belief will pervert the evidence of their own senses is sometimes ridiculed or resented; but, unfortunately, I have seen too many instances of such perversion to doubt its prevalence. It is sometimes conscious, sometimes unconscious. Even when conscious, it is frequently without sense of wrongdoing. "Why should I put down an observation which I know can't be right?" the boy will ask in perfect innocence.

The meaning of this passage is not perfectly clear to us, for we are sure that Professor Hall recognizes as forcibly as we do the essential rôle which verification plays in all scientific work. Is it scientific never to verify your conclusions experimentally? Is it not an extremely important and fundamental characteristic of the scientific attitude of mind to hold all conclusions subject to alteration should they at any time or in any way fail to be verified by experiment?" To teach students to avoid verification because they are in the process tempted to "fudge" their reports, seems to us to be doubly unfortunate; first, because the student who will "hunt only for evidence in favor of a conclusion" or will "pervert the evidence of his own senses" has failed to grasp the very heart of scientific attitude of mind, namely, sturdy integrity; and, second, because in failing to teach students to hold all conclusions subject to verification, we are encouraging a dogmatic attitude which is always disastrous in so many, many ways. If the introduction of experiments as verification leads to conscious or unconscious perversion, we can hardly escape the conclusion that the students have marvelously failed to have duly impressed upon them the fact that open-mindedness and sincere honesty are the prime essentials of the scientific thought as well as of individual character and culture.

The last chapter, on "Physics Teaching in Other Countries," is very interesting

and well done. In fact, the book improves as it proceeds. As stated at the outset, we would urge every teacher of physics to study the work carefully, as he cannot fail to be helped thereby in gaining greater definiteness of aim in his work.

But one word more. In chap. 2 attention is called to the value of including some history of physics in the work. This is important, for not only can the teacher interest the members of his class by giving them "a brief account of the long contest which beginning in the time of Newton, ended in the final establishment of the undulatory theory of light," but he can also thereby add a very important element to the instruction by so presenting the history that the students grasp the fact that the ideas make up the real life of physics, and that those ideas develop and grow according to a law of evolution which is the same as that manifested in the other branches of human thought. While the scientific method of thought, whose attainment we hold to be the real excuse for instruction in physics, serves as a unifying bond between the various sciences, so it will be found that the historical evolution of ideas, when properly discussed, furnishes a chain which connects physics vitally with the other fields of human thought.

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SOME BOOKS ON ENGLISH.

Chaucer: Prologue, Knightes Tale, Norme Priestes Tale. Edited in Critical Text, with Grammatical Introduction, Notes, and Glossary. By MARK H. LIDDELL. New York: The Macmillan Co., 1901; $0.60.

THIS edition of Chaucer's best-known tales contains a very valuable grammatical introduction, fully indexed, which also does duty as an elementary grammar of Middle English. As such it will be very welcome to teachers and students who have not been trained in the earlier stages of our language and to whom such a grammar has hitherto been inaccessible. There is no presupposing of knowledge of Old English; in fact, the whole grammar is written from the standpoint of a beginner in Middle English. After a brief statement of Middle English dialects and the sounds and writing of Chaucer's English there follows a comparison of these sounds with those of Modern English; then follows the development of the Middle English sounds from Old English, secs. 46–88; the old Norse and old French elements are treated in secs. 89–90. In the second part the inflections take up secs. 91–187. Part III is given to syntax, secs, 188–234, and in Part IV versification, secs. 235–78, is treated. In this latter part some reference to the survival of alliteration should have found mention, for which there are some striking examples in the *Knightes Tale*, ll. 2601 ff.

After this grammar there follows a brief sketch of Chaucer's life, and then the text, based on the Ellesmere manuscript, from the readings of which, however, the editor sometimes departs without giving good reason. In a school edition the notes must necessarily be brief, but these are supplemented by a very good vocabulary.

There are some very minor details of the book which will doubtless be improved in a second edition, but these do not detract in the main from the completeness and great usefulness of the book. We can heartily commend it to all students of Chaucer and of Middle English grammar.